DOCUMENT RESUME

ED 235 018 SE 043 272

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TITLE Focus on the Syllabus. Learning in Science Project. Working Paper No. 8.
INSTITUTION Waikato Univ., Hamilton (New Zealand).
PUB DATE Nov 79
NOTE 24p.; For related documents, see ED 226 976 and SE 043 265-315.
AVAILABLE FROM University of Waikato, Science Education Research Unit, Hamilton, New Zealand.
PUB TYPE Reports - Evaluative/Feasibility (142) -- Reports - Research/Technical (143)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Academic Achievement; Course Content; *Course Descriptions; *Curriculum Development; *Educational Objectives; Elementary School Science; Elementary Secondary Education; Interviews; Learning; Science Education; *Science Instruction; *Secondary School Science; Teacher Attitudes
IDENTIFIERS *Learning in Science Project; *New Zealand; Science Education Research

ABSTRACT

The first (exploratory) phase of the Learning in Science Project focused on science teaching/learning in the Form 1 to 4 level (ages 10 to 14) and sought to identify problems and difficulties in several areas. Provided in this paper are comments obtained during structured/unstructured interviews (from teachers, headmasters, science advisers, and inspectors) and observations made by project staff related to the draft F1-4 science syllabus (the 1978 draft official science syllabus). The intent in presenting these comments/observations is not primarily to provide a balanced view of the good and bad aspects of Form 1 to 4 science, but rather to open up problem issues as project staff and others see them. Teachers' views about the syllabus are presented in the first section, addressin such issues as using or not using the syllabus, familiarity with the syllabus, and changes that should be made (including a greater emphasis on acquisition of process skills and desirable attitudes). The second section considers such issues as why science is being taught in schools and justifying the inclusion of science in the curriculum. Among the general conclusions and questions raised in the final section is the belief that the draft syllabus (presented in an appendix) contains educational and scientific weaknesses. (JN)

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LEARNING IN SCIENCE PROJECT

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FOCUS ON THE SYLLABUS

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WORKING PAPER No 8

The Learning in Science Project is an educational research project undertaken at the University of Waikato under contract to the NZ Department of Education. The project is initially investigating the problems and difficulties of Form 1 - 4 Science (10 - 14 year olds) as a first step to improving teaching and learning.

This paper is one of a set of essays which is an outcome of the exploratory phase of the project. It is our hope that feedback from these essays will assist further to clarify issues and assist us in establishing priorities for the in-depth phase of the project. Any comments our readers have on either the issues involved, or the methodology adopted in these papers, would be most welcome.

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A WORKING PAPER OF THE LEARNING IN SCIENCE PROJECT

Roger Osborne, Peter Freyberg, Keith Stead and Ross Tasker

November 1979

This is one of a set of discussion papers which focus on various aspects of Form 1-4 Science. The paper collates comments and observations, related to the topic of focus, which were obtained during the first phase of the Learning in Science Project. In this phase we were particularly concerned about problems and difficulties in Form 1-4 Science and because of this the paper is biassed toward issues as identified by pupils, ex-pupils, teachers, headmasters, science advisers, inspectors as well as by our own observers. Our intention in writing the discussion papers is therefore not primarily to provide a balanced view of the good and bad aspects of Form 1-4 Science but rather to open up problem issues as we and others see them, to a limited but wider audience than the project team.

It is our hope that our chosen readers will be prepared to talk to us about the topic under focus in this paper in terms of the following questions:

(i) Are the issues we have raised important and central issues which are of general concern?

(ii) Are there other more basic issues, or other subsidiary questions, about the topic which we have overlooked?

(iii) Which aspects of the topic could we profitably analyze further in the in-depth phase of the project?

(iv) What possible solutions to some of the issues raised could profitably be the subject of further study?

INTRODUCTION

This essay is concerned with the syllabus for teaching science in forms 1-4 of the New Zealand school system. While there is a number of meanings for 'the syllabus', in this essay we focus on the official syllabus as issued by the Department of Education in Wellington[1].

At present the official syllabus consists of the 1967 syllabus and a new draft (1978) syllabus. Teachers are told, in the introduction to the draft syllabus, that they are free to use this syllabus if they consider the suggestions it contains are more helpful than those contained in the 1967 syllabus.

In this paper we focus, in the main, upon the new draft syllabus. It seems to us that this draft represents the most up-to-date professional statement on the official syllabus; that views on this syllabus are actively being sought by the Department of Education; and finally that it is likely that any future official syllabus will develop out of this latest version.

TEACHERS' VIEWS ABOUT THE F1-4 SYLLABUS

The first comment that has to be made about the official syllabus (1967 or 1978) is that many teachers tend not to be familiar with it.

6/9/3 "Teachers have got it in their hands but (it is debatable) whether they read it."

[science adviser]

18/4/3 "To be quite honest with you I haven't had a really good look at the syllabus."

[secondary science teacher]

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1. Apart from the official syllabus, there are other syllabuses such as, the "individual teacher's syllabus" (embodied in his or her stated intentions), the "actual syllabus" (which embodies what the teacher actually does) and lastly the "individual pupil's syllabus" which incorporates all these experiences and influences which affect the learning of each member of the class.

24/5/3 "A lot of teachers at intermediate school level never see the syllabus. They don't want to see it either. They want to go to their resource person in Science and say 'What do you want me to teach? Give me the stuff and I will teach it.' "

[science teacher with primary and secondary experience]

9/16/1 "(Have you seen the syllabus?) Um ... no ... I might have a copy ... I could well have a copy of that but I didn't look at it or use it at all."

[intermediate teacher]

Why don't teachers read the syllabus? Does the syllabus tend to be written in a style suitable for teachers? The following comments have been made to us about the draft syllabus,

10/1/1 "The science syllabus is beyond the capabilities of a teacher who is not a science specialist ... you need a syllabus that can be taught by the average classroom teacher in the typical classroom situation."

[intermediate Principal]

6/10/2 "The whole language of that draft syllabus is incomprehensible to a hell of a lot of teachers."

[secondary science adviser]

24/5/2 "In my experience most primary teachers would be lost by that sort of statement (the way objectives are specified in the draft syllabus)"

[ex-primary science teacher]

In this respect the introduction to the draft syllabus comes in for particular criticism,

35/6/3 "Most teachers don't read the intentions, they regard it as guff."

[secondary science inspector]

73/6/2 "there's a syllabus and there's a profile introduction to the thing which states many glorious educational aims ... but, hell's bells ... to try and get it across to kids is another story."

[intermediate teacher]

What are the comments of those teachers who have read the draft syllabus and consider they have comprehended it?

26/3/2 "actually I quite like it ... it's more or less what we have been doing all the time."

[secondary science teacher]

34/11/3 "I have a feeling that people are going to read that and they are going to say that is what I am doing already in terms of content, because that is what they are interested in ... they will do the inclusive exercise of looking
34/13/2 through that and saying 'I do all of those things' but they need to do the exclusive exercise, looking through it and saying 'I don't need to do those'. "

[science inspector]

Then there is the question of the status of the syllabus, whether 1967 or 1978. While undoubtedly some teachers treat the syllabus as a bible - for example even the order of topics in the syllabus has a considerable influence on what is taught in schools - there are teachers who regard it as a guide rather than as a prescription.

25/22/3 "The statements that are in any syllabus, or what-have-you, are a committee's view of something or other ... if you treat them in that way, then that's not a bad sort of perspective ... But if you take them as being the gospel according to someone or other then you are in dead trouble"

[HOD Science]

Others do not teach to the official syllabus and may feel uneasy about this,

27/2/2 "I regard (what I did) as being successful (but) I would be embarrassed if I was to be looked at closely ... you know someone to come along and say well how does this fit in with school requirements (and the syllabus)."

[intermediate teacher]

Not surprisingly, teachers may often be more influenced by previous 'successful' teaching experiences (their own or observed) rather than by the syllabus. One teacher who said she was not conversant with the syllabus at all stated,

9/16/2 "I hatched some chickens in my room a year or two ago ... I must do it again, it was incredible ... I was off a farm and I've seen chickens hatch and I thought well maybe they haven't. Well, two thirds of the class had never seen anything come out of an egg before ... We started off - I got the eggs in the incubator ... had to turn them twice every 24 hours ... when those eggs hatched I've never seen kids' faces like it ... this was the highlight of the whole year ... they are deprived especially in this area (city school) of experiences like that"

[intermediate teacher]

With the 1978 Draft Syllabus there is even the question of the status of the draft syllabus objectives. One of the members on the syllabus writing team with whom we talked was not sure if the stated objectives were to be envisaged as the syllabus
34/12/3 objectives or whether they were to be envisaged as examples of objectives that might be achieved.

Considering all the above points of view is it surprising that an inspector made the following comment about the draft syllabus?

34/11/2 "teachers are not going to change their behaviour as a result of that document (draft syllabus)."

and went on to state

34/11/3 "I think that the only way we are going to get teacher behaviour changes is through the back door, through written materials."

The influence of the teachers guide materials, written by experienced teachers to provide more detailed guidance for teachers on how and what to teach, and the relationship between these written resource materials and the syllabus, will be explored more fully in FOCUS ON RESOURCES.

Is it really necessary, if additional teachers' guide material is available, for classroom teachers to be provided with an official syllabus at all? Perhaps so,

39/3/1 "She (junior colleague) said 'why am I going to do (teach) this' - it was that mixtures thing we are doing - and I said 'first of all lets see what the syllabus says' and she read through that with me and she said 'oh, I know all that'. And I think we often tend not to go back to the syllabus and look at what we are meant to be teaching ... because when you know what you should get at the end, it makes all the rest seem to fall into place."

[experienced intermediate teacher]

Let us now specifically consider the change in emphasis in the draft syllabus when it is compared with the 1967 syllabus. The draft syllabus states,

"A decade of experience has indicated a number of difficulties (with content). Also increased knowledge about children's learning and development of skills and attitudes made a review of the syllabus desirable ...

. . . . .

It will be noted that the revision affects mainly the manner of presentation and weighting of emphasis rather than the substance of the present syllabus. Particular difficulties which have been identified have been modified or removed."

[Draft Syllabus Preface]

Most people who have talked to us about the kinds of changes incorporated in the draft syllabus do indeed see the intention behind the draft as a decrease in emphasis on children acquiring knowledge - particularly difficult concepts - and an increased emphasis on their acquisition of process skills and desirable attitudes.

34/4/2 "I consider one of the major difficulties with the 1967 syllabus is that it doesn't take into consideration the mental maturity of kids."

[secondary science inspector]

84/6/2 "I think the new draft syllabus is a very promising syllabus ... I think the renewed emphasis on processes is going to be first rate."

[primary inspector]

25/23/2 "(there is a need for) a statement of process skills and attitudes that are important and can be developed through science courses."

[HOD Science]

24/11/1 "(in the new draft) interests and attitudes are brought in and they are obviously given quite heavy weighting ... there is a statement that content is not the only thing ... so in those terms it's quite good."

[secondary teacher]

However some feel that more radical changes might have been made

6/7/3 "what saddens me about F1-4 (Science), is why has the F1-4 course not been modularized? ... there has not been the

6/20/2 thinking behind this thing (F1-4 Draft) at all ... I am not sure that the people who have written this thing have come to grips with what I consider is the biggest problem ... that is what should be taught at any given level in the course."

[secondary science adviser]

17/22/3

"the current curriculum (draft) ... looking at it from my point of view seems to have evolved very haphazardly. It's sort of happened rather than planned ... there has been a very superficial pruning of the curriculum without any fundamental changes or anyone sitting down and having a look and saying, what are we really trying to get across?... What is our end point? ... have we got one end point or have we got several end points in mind for different pupils?"

[secondary school teacher]

Should we have different syllabuses for children with different levels of ability? A number of people have commented to us on the desirability of this. It has also been suggested that this draft syllabus cannot successfully be taught to the lower 30% of children in the ability range,

36/3/2
17/14/3
18/9/3
20/8/2

58/2/1

"I am sorry but I am now convinced that there is a substratum if you like for whom (the teaching of science as outlined in the syllabus) is just not possible ... I guess its about one third of the kids ... at least one fifth of them."

[retired science inspector]

20/8/3

"I would say that for the bottom three (classes out of 13 classes) you should be operating on a separate scheme ... you shouldn't try and adapt the 3 & 4F syllabus too closely ... in fact you shouldn't follow those guidelines too closely for these pupils."

[ROD Science]

In summary, most of the above comments suggest that at least there are some continuing problems with the syllabus (1967 and 1978). Many teachers, for example, do not read the syllabus; rather they will tend to refer to the written resource material and textbooks, particularly where these provide clear guidelines. Some teachers who do read the draft syllabus find it incomprehensible and some who understand it nevertheless consider that essentially it says no more than what they do now anyway. Is the document intended primarily for teacher use or is it simply a guide for those writing resource material? If it is important for teachers to be familiar with the syllabus itself, how can that be encouraged? With regard to this last question, two people have suggested to us that more opportunities for discussion are what is really required.

73/2/2

8/9/1 "guidance can be done better and far more effectively in discussion type situations with the HOD rather than handing the teacher a written scheme."

[science TC lecturer]

6/10/3 "for that particular science department it was really a good exercise to go through (with them) and actually talk about the ideas in the syllabus."

[secondary science adviser]

These comments suggest that if teachers are to understand a syllabus they have to be led through it. On the other hand, is the syllabus written in language which is easily understood by most teachers?

Of course if the official syllabus is intended primarily for people writing more detailed guide material or textbooks it also needs to be well understood by these persons.

34/4/3 "some of the original syllabus writers were horrified by the misinterpretation (by textbook writers) of the depth of treatment originally intended (in the 1967 syllabus)."

[science inspector]

Additional questions have also been raised by the comments we have detailed earlier in this essay. Has the new draft syllabus been well thought out? Is the presentation logical and clear in terms of the educational aims it espouses? Is it scientifically correct in terms of the science it is suggesting should be taught? Is the status of the syllabus, in terms of whether it is intended as a prescription or a guide, made clear? Does the syllabus introduction make it clear why the particular topics in the syllabus have been chosen? We would suggest that in the light both of the comments we have outlined previously, and also our own study of the syllabus (see Appendix A for examples), the answers to many of these questions is 'no'.

It may be argued that the syllabus is only a draft. Yet if this is so, and its inadequacies simply reflect this fact, should the draft be made so widely available for teachers to teach from and should further teachers guide material based on the draft be produced at this stage? Also, have procedures for evaluating the draft syllabus and other draft materials been considered carefully enough?

6/20/3

> "I am not clear what the trialling procedure for the 1978 Draft syllabus is ... you send out the booklet, you send out the supplementary material and you hope teachers will write back ... it is not watched closely by anyone in any given area."
>
> [science adviser]

Perhaps there are even more basic questions we need to consider. How does the syllabus and its status relate to the overall broad educational aims for science at all levels in the schools? Do we have broad educational aims for science in schools? Not only do we need to ask what status has the syllabus, but more importantly what status has science in New Zealand schools? In the next section we will focus on some of these broader issues.

A BROADER PERSPECTIVE

If the comments we have received from teachers are any indication, the broad aims of science education and the status of science in schools do not seem to be areas of general concern to teachers. Teacher comment on these topics has been rare. On the other hand many inspectors, science advisers, and teachers college lecturers do seem to be concerned about such questions as 'why are we teaching science in schools?' and 'how are we able to justify the inclusion of science in the curriculum?'

8/11/3

> "as we have moved out of the great era of curriculum innovation where the teaching of science was never questioned we now find ourselves having to justify the inclusion of science in the primary and secondary curriculum ... and I wonder how many teachers could justify its place in an educational process."
>
> [teachers college lecturer]

One teacher we talked to raised this question and addressed himself to it,

18/8/1 "if we (society) are going to continue with our technological developments then we really need to have a whole population who are at least basically aware of how things operate and are fairly aware of where science has brought us and where science should be taking us."

[secondary teacher]

Other comments made to us include,

8/11/3 "Science in schools (should not be primarily) for training a very small number of our students to become scientists ... (rather) it has a contribution to make to the development of children and as part of the culture."

[teachers college lecturer]

6/12/3 "I think what we should be doing is trying to educate kids through science not trying to teach science as science."

[secondary science adviser]

Some teachers we have talked to while not expounding on justifications for the teaching of science or the broad aims of science education, have given us some insight into their philosophy by commenting on more specific activities.

42/8/1 "As far as the biology is concerned, I tend to overlook a lot of the detail and try to create an attitude towards, plants and bush and animals and creatures. An appreciation for the environment rather than specific details about what a thing
73/5/1 eats or how big it grows. If they have got some appreciation for it they will go on in later life and take an interest in the bush and the rivers and all the creatures that live there."

[intermediate teacher]

Others see their prime aim as developing in children a
17/8/1
20/6/2
64/11/2 positive attitude to science, or developing good work habits,
8/11/3 or preparing children for the eventual external examinations. We wonder how many of these teachers have really considered why science should be taught at all in the school curriculum?

Does the draft syllabus in fact address itself to this question? Indeed on page 1 section 1.2 it is stated "why include science in the curriculum?" and the statement found there is reproduced in Appendix B. Largely it agrees with the views of those few who have made comment about overall aims, yet none of them referred to this document.

Of course it may legitimately be asked 'to whom do we have to justify the inclusion of science in the curriculum?' Pupils bring high expectations to their early science lessons (see FOCUS ON THE LEARNER) and at least in the first instance they probably don't question the inclusion of science in the curriculum. However we would suspect that for those pupils, who for one reason or another, develop a dislike for science some kind of justification is needed.

8/F/8

> "Many do not like science. For these youngsters justification in their eyes is important. The 'do this because I said so' or 'study this, it is good for you' type of statement won't wash with many kids these days."
>
> [teachers college lecturer]

But not only pupils are involved. A number of people have mentioned to us their concern about the low status of science education and this relates to justifying the place of, and the emphasis which should be placed on, science in schools, to teachers, headmasters, school boards, parents and society in general.

84/1/1

> "well I think the major difficulty, as I see it, is concerned with the support that has been given to science throughout the (intermediate) schools ... it seems to me that science is a subject that doesn't rank in the school as one of those allegedly fundamental subjects ... that is if you don't do it you can get away with it ... whereas with some other ones it is not the case ... and from the principal's point of view you very rarely see that parental complaint 'John's not doing very well in science' ... so I think that is the first difficulty - that it is not seen as a front line subject ... therefore teachers don't carry it through to the extent of others."
>
> [primary inspector]

64/8/3 A Science adviser (primary) also commented on what he considers is the low status of science in the eyes of some education boards.

Then there is the parent's view of science in schools. How valid is the following generalization?

58/11/2

> "I have a feeling about parents ... they are baffled because science is beyond their ken ... 'nothing like this happened in my day' ... and therefore the parents are hostile ... also, children are the products of their parents' ignorance."
>
> [retired science inspector]

And what of society? How many employers look specifically for a background in science in their new recruits?

Perhaps, then, teachers and curriculum developers need to consider very carefully the basic question 'why teach science?'

8/11/3

> "As a teacher there didn't seem to me to be any sort of guidance, wisdom or informed opinion on science education in New Zealand ... is there a science education policy? ... I wonder if teachers college people engaged their students in thinking about the place of science in the primary school or secondary school curriculum ... I know this didn't happen to me but it is a point that I hope we do here ... 'why teach science?' "
>
> [teachers college lecturer]

Does the single paragraph in the draft syllabus on 'why include science in the curriculum?' answer this question? If so, does the syllabus logically and with justification translate the reasons into specific objectives and content? How do we get teachers to consider the question 'why teach science?' What answers do we give them? In the United Kingdom and Australia serious consideration is being given to this question (see Appendix C). Who has the master plan for science education in New Zealand schools?

In summary, we have been led from a consideration of the syllabus to focus on what we see as some broad but basic questions. It would seem to us that only in the light of answers to such basic questions as,

(i) why are we teaching science in schools?

(ii) what are the broad aims of this teaching at various age levels?

(iii) how do these aims compare with, and relate to, the aims associated with other subjects in the curriculum?

can one begin to answer such other questions as,

(iv) should there be a syllabus and what status should it have?

(v) should there be a number of different syllabuses for different ability groups? and

(vii) who should decide the format and content of any particular syllabus?

Does the lack of comment from teachers on the basic issues indicate that there is no concern amongst teachers about these questions? Do teachers assume that somebody else has responsibility for devising the syllabus, or have they excused themselves because they are too busy or under too much other pressure? Young teachers in particular are naturally concerned with survival, with short term goals of apparent pupil satisfaction with individual lessons, with finding tasks which keep pupils busy. We have mentioned in the introduction various curricula - the official syllabuses, the teacher's intentions (the 'teacher's' syllabus), the teacher's science teaching (the 'actual' syllabus) and the pupil's 'received' or 'experienced' syllabus. In terms of the latter, the question one must ask is what real influence does national aims and even the syllabus have on pupil learning? Are the broad sorts of questions about aims, justification and relevance, which we have raised above, really as important as we think?

CONCLUSIONS

In the first part of this paper we focussed on comment about the syllabus and in particular the 1978 draft syllabus. In general these comments reflected a general appreciation of the change in emphasis from the 1967 syllabus. Many teachers we have talked to perceive the draft as basically not too different from what they do now. In this regard some consider that more radical and basic changes should have been made - for example different syllabuses for children of different abilities. Not all teachers are familiar with the syllabus (1967 or 1978) and there are teachers who find it difficult to comprehend many statements in the syllabus particularly the introduction to the draft syllabus. The status of the syllabus (1967 or 1978), in terms of whether it is a prescription or a guide, varies amongst teachers and the status of the specific topic objectives in the draft syllabus is not clear. We believe also that the draft syllabus contains unfortunate educational and scientific weaknesses (Appendix A).

This focus on the syllabus has led us to a discussion of broader science education issues. While the draft syllabus does make an attempt to justify the place of science in the curriculum to teachers, the question remains, is this justification adequate? We would suggest that there is a need to justify science to many other people beside teachers. We also consider that, before many of the questions raised about the syllabus can be answered, we all need to be clear how science in schools relates to, and is part of, the broad educational aims of primary and secondary schooling.

This paper has raised many questions. Unfortunately we have few answers. Perhaps some of the questions have no simple answers. However we do feel that there may be something well worth thinking about in the following comment,

8/F/S

> "what we need is more curriculum development rather than curriculum investigation."
>
> [teachers college lecturer]

All our focus papers have been written to initiate discussion about aspects of Form 1-4 Science teaching and learning. This paper is no exception and we would appreciate your comments on any or all of the points we have raised.

ACKNOWLEDGEMENTS

We are grateful to all those people who so freely talked to us about F1-4 Science. We also wish to thank the teachers and pupils who so willingly allowed us to join them in their classroom activities.

APPENDIX A: EXAMPLES OF WHAT WE CONSIDER ARE EDUCATIONAL AND SCIENTIFIC WEAKNESSES IN THE 1978 DRAFT SYLLABUS

A1: LACK OF CLARITY IN EDUCATIONAL THINKING ABOUT AIMS AND OBJECTIVES

If science teachers are to really think about what they are trying to do, the syllabus should specify clear overall aims. These should then be broken down, in the syllabus, into more detailed general course objectives and these, perhaps, into specific objectives for topics. If such sets of aims and objectives are to make sense to teachers then there needs to be straightforward and clear relationships between one set of aims and the next.

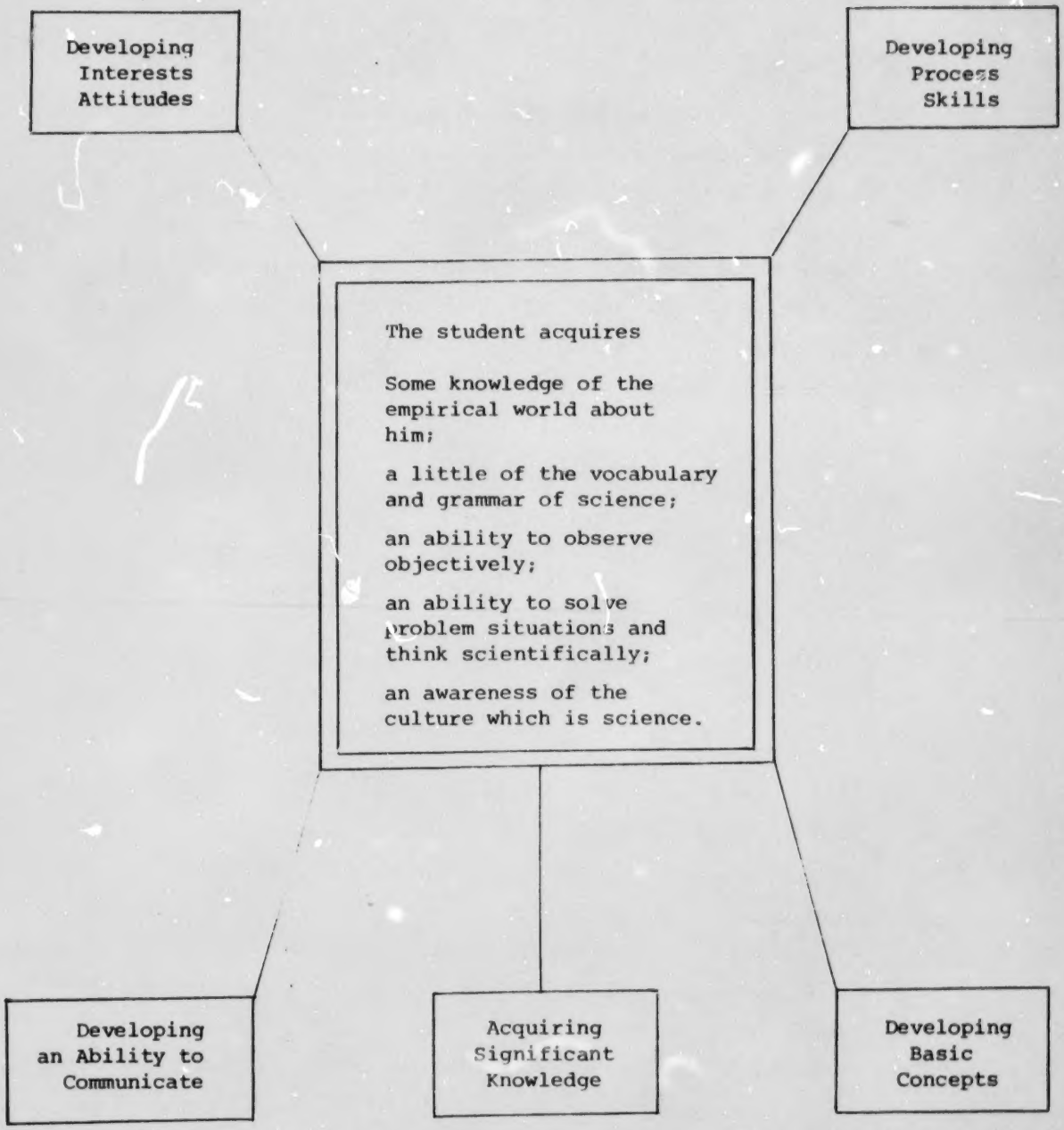
The three classes of aims and objectives mentioned above do exist in the draft syllabus but their interrelationship would appear tenuous in the extreme. On p2 of the draft syllabus there are not one but two sets of aims (see Fig 1). The aims in the central box do not relate easily to the five general aims in the smaller boxes.

From p4-13 generalised course objectives are provided under three headings, interest and attitudes, process skills, knowledge and concept development. Again these three broad areas do not relate simply to the five general aims in Fig 1. Also within any one of these areas there is some confusion. For example

(i) the discussion of interests and attitudes (p4-7) emphasises desirable habits for doing science and good study habits. However, little comment is made regarding the encouragement of positive attitudes (feelings) toward science, or of specific interests in science.

(ii) The process skills listing (p7-12) includes a list of skills some of which (e.g. experimenting) encompass others on the list so that it is difficult to isolate and clarify the various types of process skills which are to be developed.

FIGURE 1: AIMS AND OBJECTIVES


Developing Interests Attitudes
Developing Process Skills
The student acquires
Some knowledge of the empirical world about him;
a little of the vocabulary and grammar of science;
an ability to observe objectively;
an ability to solve problem situations and think scientifically;
an awareness of the culture which is science.
Developing an Ability to Communicate
Acquiring Significant Knowledge
Developing Basic Concepts

(iii) The knowledge objectives, in the knowledge and concept development listings (p13), include components which many would consider process skills.

As far as the specific objectives listed under each topic (p22-47) are concerned, no relationship (except with respect to the broad headings of content, skills and attitudes) appears to exist between these objectives (which largely describe activities which children are expected to be able to do) and the generalized course objectives (which describe abilities which children are expected to have acquired). In addition to this what is a teacher expected to make of similar activities which are defined under one topic heading as 'content', and under the next as a 'skill' or an 'attitude'? For example

(i) relate separation techniques to everyday situations (attitudes 3a, p26)

relate the differences in ... to differences in ... (content 1c, p29)

(ii) classify surfaces into good and poor reflectors (content 1d, p24)

classify rocks in various ways (skill 2b, p25)

In addition to these difficulties there is also conflict between specific objectives. For example, in Section 5, p26, objective 1(g) states 'explain the behaviour of mixtures in terms of a model of matter.' This objective is in conflict with the note that qualifies the stated aim of this section. This note indicates that 'students may wish to seek some explanation for their observations and in doing so may develop a theoretical model ...'.

What then are teachers supposed to make of all these sets and types of objectives. Are we being unfair if we suggest it is not surprising that teachers find this aspect of the Draft 'difficult to comprehend'; and regard it as 'guff'?

6/10/2
35/6/3

A2: LACK OF CLARITY IN SCIENTIFIC THINKING ABOUT CONTENT STATEMENTS

The content statements in the syllabus are minimal. However even within the minimal statements there are examples of a lack of clarity in scientific thinking. For example,

(i) 'To encourage investigations of radiant energy as an energy form' (section 3, p24).

What is really meant by radiant energy here? Content objective 1(a) states 'Identify sources of radiant energy (heat and light) e.g. sun, candle, electric light, and the heat of the body.' This statement confuses further because (i) all heat is not radiant energy, and (ii) the word heat is used in two different ways which may lead to the conclusion by some that the sources contain, rather than emit, radiant energy. The 'heat of the body' is an unfortunate expression, more correctly a body contains internal energy and the word heat should be restricted to a transfer of energy. ('Work' and 'heat' are two forms of energy transfer, and radiant energy is one form of heat.)

(ii) 'To develop ideas of electrical energy ...' (section 7, p28)

This section mentions the word electricity - what does this word mean? electric charge? electric current? electrical energy? Physicists have no precise meaning for this word and it is no wonder that its use leads to considerable confusion in the minds of pupils.

(iii) '... Friction and gravity are considered as forces which oppose movement and the application of forces in everyday life is stressed' (section 10, p31).

Frequently both frictional and gravitational forces in everyday life do not oppose movement. Consider the following everyday life examples,

(a) gravitational forces and a ball (or anything else) falling to the ground,

(b) frictional forces and a person walking or a car accelerating,

(c) gravitational forces and a car moving along a horizontal road.

One suspects that for every everyday life example where frictional or gravitational forces oppose movement an example can be found where these forces do not oppose movement!

(iv) 'Describe ..., some obvious adaptive features of each organism and say how these influence the organism's way of life' (section 1, 1e, p22)

The use of 'influence' in this context implies that an organism's life style is determined by the adaptive features it possesses. In terms of evolutionary theory this puts the cart before the horse; adaptive features are responses to environmental selective pressures and, as such, follow rather than direct.

APPENDIX B: WHY INCLUDE SCIENCE IN THE CURRICULUM?

Science is shaped by our culture, and is shaping our culture. A science programme should contribute to the growth of an individual by aiding:

> the development of an inquiring mind and the attitudes, skills and knowledge for exploring and interpreting the environment;
>
> the acquisition of the knowledge, values and attitudes of science which are part of our cultural heritage;
>
> the preparation of the person to take a place as a citizen in a society where community participation, vocation and recreation may depend on a knowledge of both the products and processes of science.

The skills of learning developed through science are not unique to this part of the curriculum. The nature of science, however, enables the products of these skills to be tested and refined in a way which demonstrates their limitations.

[Draft syllabus, p1]

APPENDIX C: CONSIDERATION OF 'WHY TEACH SCIENCE?' IN THE UNITED KINGDOM AND AUSTRALIA

In recent years a number of people in the United Kingdom have sought discussion on the place of science in schools. An example of this was the Presidential address of Lord Bullock to the Association for Science Education Annual meeting in Oxford in 1976 (Bullock, 1976). More recently the ASE have brought forward a consultative document 'Alternatives for Science Education'. In the introduction it states (ASE, 1979, p7)

> "The aim of this document is to present alternative courses of action that may be followed by those concerned with the place of science in education. It has been prepared by a working party comprised of members of the Association for Science Education who, between them, have experience of most sectors of education, with considerable help from other members whose views and suggestions are gratefully acknowledged. We hope that our contribution will be of value both to educational administrators who, in implementing plans and providing resources, need to consider the place of science in the curriculum, and also to science teachers whose willing and informed participation is essential."

Perhaps members of the PPTA Science curriculum panels and the NZEI Maths and Science consultative committee should form a working party in New Zealand to carry out a parallel exercise.

In Australia, the Australian Science Education Project has given careful consideration to such questions as 'why teach science?' and 'what are the basic aims of science education?' The booklet 'A guide to ASEP' (ASEP, 1974) sets out in clear terms the broad aims of ASEP materials and then considers each of these in some depth. Included in the evaluation process was concern for philosophical validity, i.e. do the materials reflect the aims of, and positions taken, by the Project. The criteria for the choice of the particular ASEP topics that form the course are also detailed in the teachers guide. Could we not benefit from a similar questioning of our objectives in science education in this country?

Bullock, Lord, Presidential Address: Science - a tarnished image. The School Science Review, V56 (201) June 1976, p621-627.

ASE Alternatives for Science Education, Hatfield, Herts, Association for Science Education, 1979.

ASEP A Guide to ASEP, Melbourne, Victoria; Australian Science Education Project, 1974.